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GROUNDWATER QUALITY IN PRINCE EDWARD ISLAND
HYDROGEOLOGY, QUALITY CONCERNS, MANAGEMENT

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ABSTRACT

Prince Edward Island obtains practically all its water supply from a bedrock aquifer in the fractured sedimentary rock that covers virtually the whole Island. Well yields of at least 0.5 L/s can be found almost anywhere in the province and yields as high as 75 L/s can be found in municipal wells. About 35,000 people are served by 41 municipal wells and another 93,000 by 35,000 private wells.

The fractured bedrock aquifer is covered by thin, often permeable overburden and is generally quite susceptible to contamination. The main concerns for water quality and groundwater management are above ground and underground petroleum storage tank systems, petroleum spills, agricultural chemicals and wastes (nitrates, pesticides, and manure), sewage disposal systems, the appropriate construction and maintenance of wells to prevent bacterial contamination, the sealing of abandoned wells (especially hand-dug or shallow drilled wells), road salt, seawater intrusion, and waste disposal sites.

The main legislative instrument to manage groundwater is the Environmental Protection Act, especially the provisions that give the province exclusive control over all waters and provide for environmental impact assessment, and the regulations regarding well drilling and petroleum storage. Increasingly, Environmental Impact Assessments and the provisions of the Planning Act are being used to make groundwater management an integral part of all land use planning and all development, to an extent as yet unknown in other parts of Canada.

The principal agency responsible for groundwater management is the Water Resources Branch of the P.E.I. Department of the Environment, which monitors groundwater quality and quantity, maintains groundwater data bases, enforces the well drilling regulations, provides instruction for well drillers and installers of petroleum storage tanks and licenses them, assists in problems of groundwater supply and quality, and develops and applies methods for groundwater management (mapping, classification, land use planning and environmental impact assessments, etc.). In these and other tasks, the Department of the Environment collaborates with other provincial departments such as Health and Social Services, Community and Cultural Affairs, Transportation and Public Works, and Agriculture, and the Pesticides Advisory Committee. The Department of the Environment has also concluded agreements with Environment Canada to collaborate in the evaluation of groundwater resources, groundwater monitoring, and the development and transfer of technologies related to groundwater.

RÉSUMÉ

Presque toute l'eau utilisée à l'Île-du-Prince-Edouard provient d'un aquifère du substrat rocheux dans le roc sédimentaire fracturé qui couvre pratiquement la totalité de l'île. On peut trouver des débits d'exploitation d'au moins 0,5 l/s à peu près partout dans la province et des débits d'exploitation allant jusqu'à 75 l/s dans les puits municipaux. Quarante-et-un puits municipaux desservent une population d'environ 35 000 habitants et 35 000 autres puits privés desservent 93 000 habitants.

L'aquifère du substrat rocheux fracturé est couvert d'une mince couche de sédiments meubles, souvent perméables, et il est en général très facilement sujet à la pollution. Les principaux problèmes de qualité de l'eau et de gestion des eaux sont liés aux réservoirs en surface et souterrains de stockage du pétrole, aux déversements de pétrole, aux produits chimiques et aux déchets agricoles (nitrates, pesticides et fumier), aux systèmes d'élimination des eaux usées, à la construction et à l'entretien appropriés des puits pour prévenir la contamination bactérienne, au scellement des puits abandonnés (en particulier les puits creusés ou forés à la main), au sel de voirie, à la pénétration de l'eau de mer et aux sites d'enfouissement.

Les principaux mécanismes législatifs pour gérer les eaux souterraines sont l'Environmental Protection Act, notamment les dispositions qui donnent à la province le contrôle exclusif de toutes les eaux et prévoient l'évaluation des incidences environnementales, et les règlements concernant le forage des puits et le stockage du pétrole. De plus en plus, on a recours à l'évaluation des incidences environnementales et aux dispositions de la Planning Act pour faire de la gestion des eaux souterraines une partie intégrante de toute la planification de l'utilisation et de toute la mise en valeur des terres, dans une proportion encore inconnue dans les autres régions du Canada.

Le principal organisme chargé de la gestion des eaux souterraines est la direction des ressources en eau du ministère de l'environnement de l'I.-du-P.-E. qui surveille la qualité et la quantité des eaux souterraines, garde à jour les bases de données veille à l'application des règlements de forage des puits, dispense les instructions aux foreurs de puits et aux installateurs de réservoirs de stockage du pétrole et leur octroie les permis nécessaires, aide à régler les problèmes d'approvisionnement et de qualité de l'eau, élabore et met en oeuvre des méthodes de gestion (cartographie, classification, plan de l'utilisation des terres et évaluation des incidences environnementales, etc). Pour l'exécution de ces tâches et d'autres le ministère de l'environnement collabore avec d'autres ministères et organismes provinciaux comme les services de santé et de bien-être social, les affaires communautaires et culturelles, le transport et les travaux publics, et le comité consultatif sur l'agriculture et les pesticides. Le ministère de l'environnement a également conclu des ententes de collaboration avec Environnement Canada pour l'évaluation de ressources en eaux souterraines, la surveillance, la mise au point et le transfert des technologies liées aux eaux souterraines.

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INTRODUCTION

This report describes the existing groundwater resources and quality in Prince Edward Island, environmental concerns relating to groundwater quality, and the tools available for groundwater management and protection (legislation, institutions, and programs). It is one of a series that covers the ten provinces and two territories of Canada. While the report deals primarily with groundwater quality, groundwater quantity and management of groundwater are also discussed Groundwater quality and quantity are so closely related that in many cases they need to be considered together.

The report is organized into five sections:

1) the hydrogeology and related data,

2) groundwater quality concerns either caused by human activity or of natural origin,

3) the legal basis for groundwater management ("legislative instruments"),

4) the provincial institutions for groundwater management ("institutional instruments"), and

5) specific programs (i.e. monitoring, data collection, classification and management plans, technical and financial assistance, etc.).

The report was produced jointly by the State of the Environment Reporting Branch, the National Hydrology Research Institute of Environment Canada, and the Department of the Environment of Prince Edward Island. Many provincial and federal officials provided support and assistance in the form of information and reviews. Because the responsibility for our water resources lies primarily with the provincial governments, and it is the provincial officials who deal with groundwater issues every day, their support and collaboration is particularly valuable.

This report, together with those of the other provinces and territories, has several purposes. First, the reports will form the basis for a forthcoming overview of groundwater in Canada. That overview will be part of a new federal effort to report on the state of the environment of Canada, an effort tied to the goal of sustainable development. Second, the reports attempt to provide comprehensive information on the different concerns and activities related to groundwater in each province and territory. Thus, they can be useful for anyone involved with groundwater; the public, consultants, industry, or officials of different levels of government. In effect, the report can form a bridge between different groups and help them to better understand each others' concerns, goals, and endeavours. Finally, the reports provide a description of how groundwater concerns are dealt with in the various jurisdictions of Canada. With luck, this may lead

to increased awareness and form the basis for future collaboration between different jurisdictions.

On Prince Edward Island, with its complete dependence on groundwater and with its vulnerable aquifers, almost any aspect of environmental management and protection has an impact on groundwater. During the preparation of this and the other reports in the series, it has become apparent that the best approach to manage groundwater is to see it as part of overall water management and overall environmental management. In most cases, the appropriate tools for groundwater management are legislation, institutions, and programs for overall water management, and for the management of waste, pesticides and other potential pollutants, rather than for groundwater management alone. This may reflect the nature of groundwater management, indicating that groundwater and its management should be considered as part of a much larger picture and not as an isolated concern.

Prince Edward Island is also unique in that, to a degree unprecedented in other parts of the country, it is making groundwater management an integral part of land use planning. Following a worldwide trend (Freeze and Cherry, 1989), the province has begun to direct potentially threatening activities and developments away from sensitive and important water supplies. In addition, before any major development in the province is allowed to proceed, its source of water has to be assured and it must be shown that the development and any activities connected to it (e.g. construction, waste generation, etc.) will not endanger its own supply or any other groundwater supply. Such an approach is far more efficient and beneficial for the economy as a whole than it is to spend large sums and effort on remediation (in many cases unsuccessfully) or to be forced to relocate already established developments or their water supplies (Cherry, 1989).

1. HYDROGEOLOGY

1.1 CLIMATE, TOPOGRAPHY, AND RECHARGE

Prince Edward Island is on one of the ancient floodplains of the Appalachian region (Randall et al., 1988). Climate is temperate marine with annual precipitation about 1,100 mm, fairly evenly distributed throughout the year (Fisheries and Environment Canada, 1978). Recharge is quite high and ranges from 25 to 35 percent of precipitation. Topographically, the Island is lowland and gently rolling farmland with maximum elevation of 140 metres and most slopes between two and eight degrees.

1.2 BEDROCK

1.2.1 Hydrogeology

All bedrock on Prince Edward Island is sedimentary rock of alluvial origin formed during Permian and Carboniferous ages (the "Prince Edward Island Redbeds"). Igneous rock is found at depths between 1,500 and 2,500 m and at one intrusion on George Island (Hog Island). The sedimentary rock is composed of sandstone, siltstone, mudstone, mudstone breccia, and conglomerate; 70 to 75 percent of it consists of sandstone. It forms the major aquifer across the province, the only one that is exploited. The rock is generally flat-lying with extensive crossbedding, lensing, discontinuities, and rapid facies changes (Van de Poll, 1983).

Different bedrock units have been identified according to their ages and the fractions of sandstone relative to conglomerate or breccia (Frankel and Crowl, 1970; Van de Poll, 1983). However, since the hydrogeologic characteristics are determined primarily by fractures which are found in all strata - where they are not very homogeneously distributed - such a classification is of limited use within the scope of this overview.

Total porosity is determined primarily by the intergranular porosity of the sandstone which averages about 16 percent (Francis and Gale, 1988). Permeabilities are essentially determined by fractures (most of them along bedding planes), joints, and faults (Francis, 1981; Francis, Gale, and Atkinson, 1984; Francis and Gale, 1988). Significant groundwater flow occurs along horizontal bedding planes, joints, and fault zones. As expected, fracturing decreases with increasing depth and may vary considerably over short distances. Therefore, permeabilities and yields may vary considerably from well to well and generally decrease with depth.

The most permeable portion of the bedrock aquifer is generally the upper 75 m, but productive zones have been found at depths of 150 m. The water table is between 0 and 60 m below the surface with average depth between 10 and 20 m.

1.2.2 Hydraulic Conductivities, Well Yields and Flow Rates

Hydraulic conductivities have been determined primarily for the Winter River Basin which contains the well fields for the City of Charlottetown (Callan, 1978; Francis, 1981; Francis, Gale, and Atkinson, 1984; Francis and Gale, 1988; Francis, 1989a). Values decreased with depth from about 10^{-3} m/s to 10^{-7} m/s, the lowest values being equivalent to the intergranular hydraulic conductivity of the sandstone matrix. Francis and Gale (1988) found an average value of 10^{-4} m/s for the hydraulic conductivity in the upper portion of the aquifer and an average decrease by a factor of 10 for each 60-m depth; the decrease appears to be caused by a decrease in fracture frequency and fracture aperture with depth. They concluded that "drilling wells to depths beyond 75 to 100 m in the hope of increasing well yields is not likely to be cost-effective".

Municipal wells in the well fields near Charlottetown and Summerside have average yields of 15 L/s, some even up to 75 L/s. Average industrial or municipal well yields of 15 L/s may be expected throughout the province. Domestic wells invariably have yields of at least 0.5 L/s.

The flow system is primarily controlled by topography. Thus, with the generally gentle slopes, very low values for hydraulic gradients can be found. Still, flow rates range from 0.3 to 6 m/s (Jardine, 1988) because of the high permeabilities in the fractured rock. Flow through the unsaturated zone can be at a much higher rate.

1.2.3 Groundwater Chemistry

Groundwater is usually slightly alkaline, of the calcium magnesium bicarbonate type. Deeper wells near the end of the groundwater flow systems in Queens and Prince counties contain very soft, highly alkaline water of the sodium bicarbonate/sodium carbonate type (pH 9 to 10) because of ion exchange in the claystone and siltstone in the aquifer (Francis, 1989a). In some locations (e.g. Miminegash), where older geological formations are found, this type of water is also found close to the surface. Such softer waters, often lacking in dissolved oxygen, are more likely to contain iron or manganese.

1.3 HYDROGEOLOGY OF THE OVERBURDEN

Prince Edward Island is overlain by thin glacial deposits of sand, sandy till, or clay till. A detailed map of these surficial deposits has been produced by Prest (1973). They are generally between 0.5 and 5 m thick with a maximum of about 20 m. Generally they do not provide useable aquifers and are not exploited. Depending upon their composition, they will influence recharge in a specific area and provide a limited amount of storage. As their thickness and clay content increases, they also provide a modicum of protection from surface contamination. Because the overburden is generally thin and can be fractured, and the underlying bedrock aquifer is extensively fractured, all areas are susceptible to groundwater contamination.

2. GROUNDWATER QUALITY CONCERNS

Prince Edward Island is moderately urbanized and derives most of its economic productivity from farming, tourism, fisheries, forestry, and aquaculture. Except for quarrying, there is no mining and no heavy industry. The main secondary industry is food processing. All water for human consumption and most water for other purposes comes from groundwater (Hess, 1986). This extensive use of and dependence on groundwater as well as the vulnerability of the aquifers explain the concern for the quality of the groundwater on Prince Edward Island and the comprehensive management being practiced. Freeze and Cherry (1979) and Cherry (1987) have discussed natural groundwater quality and groundwater contamination as a general as well as a nation-wide concern. Eaton et al. (1985) have discussed environmental quality across Atlantic Canada. On P.E.I., specific concerns relate to above-ground and underground petroleum storage tank systems, petroleum spills, agricultural chemicals and wastes (nitrates, pesticides, and manure), sewage disposal systems, road salt, seawater intrusion and waste disposal sites. Another serious concern is the appropriate construction and maintenance of wells to prevent bacterial contamination and the sealing of abandoned wells, especially hand-dug or shallow drilled wells.

Wells are dug or drilled into bedrock to a depth ranging from 10 m to 200 m. In the 1980's, the average well depth was 30 m with average casing lengths of 15 m (Walker and Partners, 1987). About 35,000 people were served by 41 municipal wells in 1987, and 93,000 people by about 35,000 private wells (Walker and Partners). An estimated 5,000 shallow wells (less than 15 m deep) exist, most of them in the western part (Prince County) of Prince Edward Island (Walker and Partners, 1987).

2.1 LEAKS FROM PETROLEUM STORAGE TANKS AND OTHER SPILLS

Petroleum storage tanks, both above-ground and underground, are a major concern and the provincial government has recently introduced strict legislation to limit the amount of contamination from these sources (see Section 5.10). The P.E.I. Department of the Environment (Water Resources Branch) has an inventory of tanks: as of 8 March 1988, there were 2,255 tanks registered in the province, 1,949 (86 percent) of which were unprotected steel tanks. Eighty-four tanks were fibreglass and 171 had cathodic protection. Between 1977 and 1987, 330 above ground spills were reported, 102 of which contaminated wells. Eighty-two wells were contaminated by 67 underground leaks in the same period. In many cases several wells were contaminated by one leak or spill (Jardine, 1988). In 1989 the Department of the Environment investigated 243 above ground spills. Five hundred and fifty-five tanks were removed and inspected in the same year; 110 of them were found to be leaking. Since 1986, 1,069 tanks have been removed.

One well known incident occurred in 1977 in Kensington, where 31 wells were contaminated by a leaking gasoline storage tank; other cases also have been reported (e.g. North River, Tignish [Beak, 1986], O'Leary). In many years, settling snow or ice causes

the collapse of pipes at above-ground tanks for home heating oil. Oil from these spills then seeps into the ground and sometimes contaminates groundwater. During Winter 1986-87, approximately 40 such cases were reported. In 1988, 39% of the reported spills were from domestic tanks at private homes.

Other types of spills also occur occasionally. For example, as a result of a fire and explosion in a pesticide warehouse at Kensington in 1984, the water in eight wells was contaminated with up to 16 µg/L of dinoseb.

Unlike other parts of Atlantic Canada, no significant contamination of groundwater by chlorinated solvents (per- or trichloroethylene, etc.) has ever been reported. Currently, the disposal of chlorinated solvents as well as dry-cleaning sludges containing them is banned at waste disposal sites on Prince Edward Island.

2.2 PROBLEMS RELATED TO AGRICULTURE

2.2.1 Agricultural Chemicals

Over 33 percent of Prince Edward Island's landmass is improved farmland, the second-highest in Canada after Saskatchewan (Statistics Canada, 1986). Effects of agricultural chemicals are concentrated in the potato-growing belt, mainly Queens and Prince counties. Prince County is especially vulnerable because of its shallow water table. Nitrate concentrations as high as 22 mg/L (as N) have been found in observation wells in potato fields (Priddle et al., 1988). Data from an island-wide data base indicates that about 2% of all sampled well water contained levels above 10 mg/L (the value of the Canadian Drinking Water Guideline, Health and Welfare Canada, 1987); the frequency of wells with nitrate concentrations above this level increased sharply on swine farms and to a lesser extent near potato fields (Francis, 1989b).

In the past, most pesticide monitoring focused on aldicarb (Temik) (Gillis and Walker, 1986; Priddle et al., 1987; Matheson et al., 1987), which was a chemical widely used on potatoes until recently. During the 1983 season, 5,000 to 10,000 kg of active ingredient were applied at a rate of 1.8 to 2.3 kg/ha on approximately 3,000 ha (Matheson et al., 1987). Up to 7 µg/L of aldicarb were found in domestic wells and up to 16.4 µg/L in observation wells on potato fields (Priddle et al., 1987). In other studies (Francis, 1989b), low concentrations of metribuzin (up to 7.5 µg/L), phorate (up to 0.2 µg/L), disulfoton (up to 0.37 µg/L), and atrazine (up to 0.84 µg/L) were found in private wells. Very low levels (below 0.5 µg/L) of parathion, disulfoton, and aldicarb were also found in a few municipal wells (Francis, 1989b). Dinoseb at concentrations above the Canadian Drinking Water Advisory (10 µg/L) were also found in three wells. In 1989, extremely high concentrations of dinoseb (up to 920 µg/L) were found in 19 wells in Tignish. The source of this contamination was apparently improper disposal or a container leak. (See section 5.1.2 of this report, points vi and vii, for a discussion of pesticide monitoring.)

The use of aldicarb was greatly reduced in 1988 and temporarily suspended in 1989. With the reduction in the use of aldicarb, concerns are shifting to other granular insecticides such as phorate (Thimet) and disulfoton (Disyston) which are also used on potatoes. A list of major pesticides used in P.E.I. and a list of pesticides of priority for groundwater assessment have recently been presented (Francis, 1989b). The two lists are reproduced below:

Table 1. Pesticides applied in P.E.I. in 1986. *

Fungicides	Herbicides	Insecticides	Seed Treatment
Mancozeb	MCPA	Phorate	Maneb
Chlorothalonil	Metribuzin	Disulfoton	Thiophanate-methyl
Metalaxyl	Diquat	Carbofuran	
Metiram	Paraquat	Aldicarb	
	Dalapon	Fenvalerate	
	2,4-D		
	Linuron		

* In 1986, 94,600, 42,400, and 15,600 kg of fungicides herbicides and insecticides respectively, were applied (active ingredient only).

Table 2. The ten pesticides of highest priority (in order) for groundwater assessment.

1. Aldicarb	6. Mancozeb
2. Phorate	7. Carbofuran
3. Disulfoton	8. 2,4-D
4. Metribuzin	9. Metalaxyl
5. MCPA	10. Chlorothalonil

Table 3. Pesticides which need to be investigated in P.E.I. groundwater (1990)

Mancozeb	Fenvalerate
Metalaxyl	Metabolites of Phorate
Chlorothalonil	Metabolites of Disulfoton
Metiram	Guthion
Thiophanate- Methyl	Phosphamidon
Linuron	Methamidophos
Maleic Hydrazide	

2.2.2 Manure Management

Manure spread on fields as fertilizer may also contaminate wells, sometimes by direct surface run-off or leaching from storage sites to groundwater. Feedlots have at times contaminated some wells on Prince Edward Island. In recent years, hog production has expanded the use of storage lagoons for liquid manure. Authorities are now increasingly concerned about groundwater contamination from these lagoons, especially from those that have been constructed without an impermeable liner, or directly into fractured bedrock, or both.

2.3 SEWAGE DISPOSAL

On-site sewage disposal systems, such as septic tanks and tile drainage fields, are a potential source of contamination. Shallow-cased wells near septic tanks can become contaminated with bacteria and other micro-organisms, nitrates, and in some cases, organic solvents. The P.E.I. Department of the Environment investigates between 10 and 20 reports of bacterial contamination from sewage systems annually. The likelihood of contamination increases when the wells or the sewage disposal systems have been poorly constructed or when the density of the sewage disposal systems is high. Wells in cottage areas, for example, are affected more often than others because cottages are usually on smaller lots close together, wells are often shallow to prevent seawater intrusion, and the tile fields (of septic systems) are often close to bedrock. Shallow, hand-dug or drilled wells, many of them found in Prince County (Walker and Partners, 1987), may also be at greater risk than deeper wells. Leaking sewer lines are also a source of groundwater contamination in residential areas served by private wells.

2.4 ROAD SALT

Road salt contamination is as much a concern on Prince Edward Island as it is in other parts of eastern Canada. About 23,000 tonnes of salt, some of it mixed with sand, are spread on about 500 km of Prince Edward Island's provincial roads every winter. Another 1,500 tonnes are spread on municipal roads in Charlottetown and Summerside (Trainor, personal communication, 1988). On average about four cases of well contamination from road salt are reported to the Department of the Environment every year. Storage piles had often been the cause of this type of contamination. Over the last few years though, some storage piles of mixed sand and salt (5-6 percent salt) have been moved to less sensitive areas, and all piles containing pure salt have been covered. This was done by the Department of Transportation and Public Works (Road Maintenance) in collaboration with the Department of the Environment. Now that the number of uncovered storage piles has been substantially reduced, road salt contamination occurs primarily along roads in areas with heavy salt application (i.e. urbanized areas), and in areas of steep contours and hilly terrain; such topography contributes to the potential of contamination. Road salt contamination has been reported in Bridgetown, Crapaud, Sherwood and Georgetown, among other places.

2.5 SEAWATER INTRUSION

The intrusion of seawater into wells occurs on Prince Edward Island either as a natural phenomenon or as a result of overpumping. Aside from its occurrence at some coastal cottage developments, it is not considered a serious problem on Prince Edward Island. Seawater intrusion caused by overpumping has in most cases been curtailed by appropriate water management. Seawater intrusion is usually limited to a specific horizontal stratum. By avoiding that stratum, freshwater can often be obtained. For example, a 122 m deep municipal well at Summerside was plugged back to 76 m to eliminate seawater intrusion Sometimes presumed seawater intrusion was traced back to anthropogenic sources such as road salt (P.E.I. Department of Community and Cultural Affairs, 1987).

Saline groundwater is often desirable for use in the expanding fishery of lobsters, mussels, and other shellfish on Prince Edward Island. Salt water wells with a salinity of 20 ppt or greater are used for lobster pounds; wells with a salinity of 15 ppt or greater are suitable for mussels and finfish. With proper construction methods, salt- and freshwater wells are found right beside each other. One of the advantages of groundwater in aquaculture is its practically constant temperature of 8°C year-round and the absence of bacterial contamination or pathogens.

2.6 HAND-DUG WELLS

Prince Edward Island has an estimated 5,000 wells that are less than 15 m deep (Walker and Partners, 1987). Many of them were dug by hand, have an average diameter

of 1 m, and are lined with stone blocks. Many of them are vulnerable to contamination, often from surface run-off.

In addition, abandoned wells of this type have been used for disposal of sewage, refuse, waste oil, and other contaminants. To prevent such misuse, and hence prevent the contamination of groundwater via these abandoned wells, the Department of the Environment established a program in 1976 to plug unused hand-dug wells. As of June 1989, a total of 1,787 wells have been plugged under this program.

2.7 CHARLOTTETOWN AIRPORT

The effects of de-icing fluids and salts, gasoline storage tanks, and spills from Charlottetown Airport on the surrounding groundwater have been the cause of some concern. The airport is located in the recharge area of the Winter River watershed which contains two well fields for the City of Charlottetown. The airport was recently expanded and the long-term effects of the expansion are not yet known. The federal government (Environment Canada, Inland Waters Directorate) has been monitoring the aquifer underlying the airport for several years. High levels of nitrate have been found in some of the monitoring wells. There is still some concern about the proper management of fuel tanks, etc. The present well fields for Charlottetown in the Winter River watershed are probably at the limit of their capabilities of production and new well fields may have to be constructed in that watershed. If land use is not properly planned, conflicts may well arise between the use of the land for the airport and the construction of new well fields for the City of Charlottetown. For this reason, surface water, groundwater, and land use in the Winter River watershed are being studied in detail in a joint federal-provincial program (see Section 5.7).

2.8 WASTE DISPOSAL

A federal-provincial study of landfill sites on Prince Edward Island was carried to Phase II (identification and preliminary assessment). Two of 474 identified sites fall under federal jurisdiction; 243 sites were active, 230 closed; 11 were classified as Priority I (Prince Edward Island 1983, 1984). Groundwater around one closed and three active landfill sites is being monitored by the provincial authorities. Samples are taken one to four times a year. The sites are the East Royalty (a closed site in the Charlottetown area), the new Charlottetown Regional site, the St. Eleanor's Regional site (serving the Summerside area), and the Cardigan Regional site in Kings County.

Another concern is hazardous wastes. At present, hazardous wastes cannot be disposed of in the province. Temporary storage sites are being considered and one such site should become available in 1990. In the past, food wastes - especially potato wastes - have also been a cause of concern and have at times contaminated some wells (e.g. New Annan) (Beak, 1986).

2.9 NATURAL CONSTITUENTS

The major natural constituents that may affect well water are iron and manganese. High concentrations of these elements are more likely to be found in groundwater in areas with very low hydraulic gradient, low dissolved oxygen and acidic pH, usually where claystone and siltstone lithologies dominate.

3. GROUNDWATER MANAGEMENT - LEGISLATIVE INSTRUMENTS

3.1 ENVIRONMENTAL PROTECTION ACT - WATER RESOURCES

Property rights of all water in Prince Edward Island rest with the Crown; the province allocates water withdrawal for different uses. The Minister of the Environment is given the power to "manage, protect or enhance the environment" (Section 3 of EPA). Specifically for water management, the Minister:

i) exercises "exclusive control over the use or alteration of all surface, ground and shore waters, and all beaches, sand dunes, and wetlands within the jurisdiction of the province", "over the allocation of the use of water", and "over the preservation of the environment";

ii) coordinates activities of other departments and agencies for the management of the environment; and

iii) prepares and publishes policies, strategies, objectives and standards.

The Act also establishes:

i) an Environmental Advisory Council to advise the Minister (Section 4 of EPA); and

ii) an Environmental Coordinating Committee composed of the deputy ministers of different departments to coordinate joint activities (Section 5 of EPA).

3.2 ENVIRONMENTAL PROTECTION ACT - WATER WELL REGULATIONS (1990)

The regulations specify who may construct a well. where and how it may be constructed, how abandoned, and how groundwater is allocated. They stipulate that well construction reports and other information must be submitted to the Department of the Environment. They require adaptation to "geologic and groundwater conditions" and sealing off of contaminated, water bearing formations while constructing a well. They also identify restricted areas where wells may only be drilled with the permission of the Minister. The regulations are administered by the Department of the Environment. Permits and licenses are issued by the Minister who may attach conditions and restrictions. At present (1990), the water well regulations of Prince Edward Island are probably the most comprehensive in the country. Specifically, the regulations state:

i) **Well Drillers' Licenses:** a well may only be constructed by a licensed well driller. An examination and a field test may be required before a license (valid for

one year) is issued by the Minister. Conditions and restrictions may be attached to that license (section 2).

ii) **Water Well Advisory Board:** A three-person Water Well Advisory Board is to be appointed by the Lieutenant-Governor in Council to conduct hearings and to make recommendations to the Minister regarding the application for a well driller's license (section 3).

iii) **Well Construction Reports:** Well construction reports on approved forms have to be completed immediately upon construction. Copies of the report have to be forwarded to the Department and to the owner, and have to be kept by the well driller (section 4).

iv) **Well Permits and Restricted Areas:** Well permits are required for all wells in restricted areas (section 5). Restricted areas are identified in schedule A. They have been so designated mainly because soil or aquifers in these areas may be contaminated and thus may contaminate wells, or in order to better manage water withdrawal in these areas.

v) **Exploration Permits:** Groundwater exploration permits are required for all wells with a diameter of 15 cm or greater, for wells which are pumped at 4 L/s or greater, for wells to be used as observation and exploration wells, and for wells used for water supply systems. Reports on these wells have to be submitted to the Department (section 6).

vi) **Groundwater Allocation and Liability:** Groundwater allocation permits are required for wells from which water is withdrawn at 4 L/s or greater, or for wells for a water supply system (section 7). This section also establishes the owner's liability for adverse effects caused by the withdrawal.

vii) **Specifications for Construction, Location, Design, Completion and Abandonment:** Wells have to be constructed "in a manner which maintains existing natural protection against contaminants" and with specified materials (section 8); at a specified distance from buildings, sewer lines, septic systems, sewage lagoons, petroleum storage tanks, etc. (section 9); and in a manner which (a) "adapts to geologic and groundwater conditions existing at the site of the well", (b) seals off water bearing formations containing contaminants, and (c) leaves no artificial openings to the well (section 10). Wells (section 11) and casings (section 10) have to be completed, well pits constructed, and pumps installed (section 13) according to specifications given in the regulations. Abandoned wells have to be filled within 30 days (section 12). Standards for equipment, and acceptable methods for grouting, for disinfecting water wells, and

for filling of abandoned wells are also specified in the regulations (schedule B, C, D and E, respectively).

3.3 ENVIRONMENTAL PROTECTION ACT - CONTROL AND STOP ORDERS

If any act or any omission contravenes the Environmental Protection Act or otherwise threatens the environment, the Minister may issue a written order to:

i) permit inspection of any premises,

ii) permit testing and sampling,

iii) cease any activity,

iv) clean or repair any area where the environment has been affected at the cost of the person responsible, and

v) restore the environment to a satisfactory condition within a specific period.

3.4 ENVIRONMENTAL PROTECTION ACT - SPILLS AND OTHER DISCHARGES OF CONTAMINANTS

No discharge of contaminants (spill or otherwise) is permitted, except by regulation or written permit. If such discharge occurs, the person who causes the discharge or who owns or has control of the contaminant shall notify the Department and take such remedial measures as required by the Minister.

3.5 ENVIRONMENTAL PROTECTION ACT - APPROVALS AND ENVIRONMENTAL IMPACT ASSESSMENTS

It is the stated policy of the government of Prince Edward Island to make the environmental impact assessment a key component of integrated environmental and economic planning for a sustainable development. The aim of the assessment is to evaluate and consider all environmental implications of an undertaking in the planning stage. All of the environment (air, land, water, plants, animals and human life) are considered. Impacts on groundwater and its present and future use are an important consideration of an assessment.

The legal basis for the Environmental Impact Assessment is section 9(1) of the Environmental Protection Act which states that "no person shall initiate any undertaking unless that person first files a written proposal with the Department (of the Environment) and obtains from the Minister written approval to proceed with the proposed undertaking."

Undertaking is defined to "include(s) any construction, industry, operation or other project, or any alteration or modification of any existing undertaking which will or may:

i) cause the emission or discharge of any contaminant into the environment;

ii) have any effect on any unique, rare or endangered feature of the environment;

iii) have a significant effect on the environment or necessitate further development which is likely to have a significant effect on the environment; or

iv) cause public concern because of its real or perceived effect or potential effect on the environment."

Written approval is required for any such undertaking. A list of different types of undertakings (industrial, agricultural, commercial, residential, related to fisheries, etc.) is available (P.E.I. Department of the Environment, 1989). A "proponent" (person or organization which owns, manages or controls the undertaking) has to prepare a proposal, and if so required by the Minister, the environmental impact assessment. The Minister may require the assessment for any undertaking which requires approval, and may also notify the public and provide an opportunity for public comment. Interim guidelines for environmental impact assessment have been published which describe the process in detail. They are summarized in section 5.6 of this report.

3.6 ENVIRONMENTAL PROTECTION ACT - SYSTEMS FOR WASTE TREATMENT AND WATER SUPPLIES

i) Written approval of the Minister is required for any waste treatment system or water supply system (for five or more households).

ii) Waste treatment systems and water supply systems have to be maintained and operated according to the regulations of the Minister. In particular, the Minister may order alteration or additions to water supply systems if water from such systems is not fit for human consumption or affects public health.

iii) The Lieutenant-Governor in Council may create Water and Sewerage Corporations for the establishment, operation, and management of waste treatment or water supply systems.

3.7 ENVIRONMENTAL PROTECTION ACT - REGULATIONS IN GENERAL

The Lieutenant-Governor in Council may make regulations for:

i) environmental standards;

ii) waste disposal and landfill sites;

iii) other systems for waste management;

iv) chemical or petroleum storage tank systems;

v) release of wastewater and other contaminants; and

vi) wells, withdrawal and use of water.

3.8 ENVIRONMENTAL PROTECTION ACT - PETROLEUM STORAGE TANK REGULATIONS (1990)

The regulations apply to all underground petroleum storage tanks and to above ground tanks with a capacity of 2,000 litres or greater. Petroleum, in the context of the regulations, includes gasoline and all other fuel for internal combustion engines, heating oil, and lubricants. They are administered by the Department of the Environment. Certificates of registration, approvals and licenses are issued by the Minister, who may attach restrictions and conditions to them, and who has the power to revoke them. Offenses under the Petroleum Storage Tank Regulations may be ticketed. A number of officials of the Department (Water Resources Branch) are appointed as provincial constables and may issue summary offence tickets which require court appearances (or guilty pleas and payment of fines). Specifically, the regulations state:

i) **Certificates of Registration and Approval:** Certificates of registration (and identification tags on the tanks) are required for all new and existing tanks (section 2). Conditional approvals are required for the installation of any new tanks and for the alteration of existing tanks (sections 3, 4 and 14). Conditions (such as containment vaults) may be attached to the approval in order to protect the environment; the approval may also be refused altogether in order to protect the environment.

ii) **Construction and Installation Standards:** Minimum construction and installation standards are required for new tanks, and for piping and associated fittings. Impressed current cathodic protection, sacrificial anodes, or containment vaults are required for underground steel tanks. Fibreglass tanks as well as steel tanks have to meet the National Standards for such tanks and the National Fire Code of Canada (sections 5, 6 and 7).

iii) **Maintenance:** Regular maintenance checks are required for storage tank systems with sacrificial anodes or impressed current cathodic protection; records of these checks have to be kept by the owners (sections 16, 17 and 18).

iv) **Tank Contractors and Their Liability:** Only holders of valid "level one" licenses may remove storage tanks; only holders of valid "level two" licenses may install or alter storage tank systems. Successful completion of a training and examination program is required to obtain either license. In addition, holders of "level two" licenses have to be insured against liability (for a minimum of $1,000,000 per occurrence) including that arising from a sudden release of a contaminant into the environment (section 9).

v) **Inventory Records:** Operators of underground storage tanks must maintain and reconcile inventory records (sections 11 and 12).

vi) **Reporting of Leakage:** Operators or any other person suspecting a leak from a petroleum storage tank system must immediately inform the Canadian Coast Guard (Telephone 1-800-565-1633) (or other number listed for this purpose) (section 13). The Minister may order the owner of a tank to conduct a leak test and may order the removal of the tank (sections 13 and 15). Leak tests may also be ordered after installation or alteration or (by the Minister) in other situations.

vii) **Tank Replacement:** Unprotected steel underground tanks older than twenty-five years will have to be removed by September 1, 1991 (or a date approved by the Minister) where they are part of retail or bulk service outlets; otherwise such tanks had to be removed by May 1, 1990. The life expectancy of unprotected steel tanks that are less than twenty-five year old, has to be evaluated by the same dates. Such tanks have to be upgraded or they have to be removed before they become fifteen years old (section 15).

viii) **Out of Service Tanks:** Storage tank systems that have been or are to be out of service for six months or more have to be emptied and purged. After twelve months, any underground tank system has to be removed together with any contaminated soil and the Minister notified (section 19). Any reuse has to be approved; otherwise the tank has to be disposed of according to approved methods.

3.9 ENVIRONMENTAL PROTECTION ACT - REGULATIONS FOR ON-SITE SEWAGE DISPOSAL SYSTEMS

The regulations specify minimum construction and operation standards for septic tanks and community and other public sewage disposal; e.g. distances from buildings, property lines and the water table. It requires inspection of completed tanks. (Licensing of installers of on-site sewage disposal systems is not required.)

3.10 PUBLIC HEALTH ACT

The Act authorizes the Department of Health and Social Services to stop any activities which endanger public health. Under the Act, specific regulations for public drinking water may be enacted.

3.11 PESTICIDES CONTROL ACT

The Act regulates the transportation, storage and disposal of pesticides and their containers as well as aerial spraying of pesticides. It is administered by the P.E.I. Department of Agriculture.

3.12 PLANNING ACT

Provisions of the Planning Act and Regulations under the Act require development permits for all construction. Thus sewage facilities, surface impoundments (lagoons and ponds), manure containments and all other facilities that may affect the environment may be controlled. The Planning Act also provides for land use planning and zoning and for municipalities to establish land use plans. Land use planning has important implications for groundwater quality protection.

The Act is administered by the Planning Division of the P.E.I. Department of Community and Cultural Affairs. Several communities have by-laws which also regulate the storage and handling of some contaminants.

3.13 TRANSPORTATION OF DANGEROUS GOODS ACT

The Act regulates the transportation, storage and some other aspects of management of dangerous chemicals. In most respects, the provisions of the federal Act are adopted. The Act is administered by the Highway Safety Division of the P.E.I. Department of Transportation and Public Works.

4. GROUNDWATER MANAGEMENT - INSTITUTIONAL INSTRUMENTS

The principal agency responsible for the management of groundwater is the Department of the Environment. Because of the nature of their activities, the Department of Highways, the Department of Agriculture, the Department of Health and Social Services, and the Department of Community and Cultural Affairs often collaborate with the Department of the Environment on groundwater management matters.

4.1 THE DEPARTMENT OF THE ENVIRONMENT

Three agencies within this Department carry out particular functions in the management of groundwater.

4.1.1 The Water Resources Branch

This Branch is the main Branch responsible for groundwater management and protection and carries out the following related activities:

i) issuing permits for groundwater withdrawal of more than 189 L/min (50 Imp. gal./min), or from wells 0.15 m (6") or more in diameter;

ii) developing and enforcing regulations for well drilling and well maintenance;

iii) monitoring groundwater levels;

iv) keeping well logs and related information (hydrogeological maps, etc.);

v) monitoring water quality (e.g. landfill sites, private and public wells, observation wells for agricultural contaminants, land use, etc.);

vi) developing classification systems, regional hydrogeological and land use map and management plans to avoid seawater intrusion, etc.;

vii) developing and carrying out specific programs for the protection of aquifers and water supply wells (e.g. sealing of abandoned wells, research and development on well construction);

viii) providing, on request, information and assistance to well drillers and owners on well construction and water quality issues;

ix) providing advice and assistance to other departments on matters related to groundwater protection (e.g. on groundwater and road salting to the Department of Transportation and Public Works, on public water supplies to the Building and Technical Services Division of the Department of Community and Cultural

Affairs and to the Department of Health and Social Services, and on pesticide applications to the Department of Agriculture);

x) developing and enforcing regulations related to underground storage tanks;

xi) giving training courses for installers of underground storage tanks once a year, holding examinations and registering installers;

xii) coordinating responses to spills (i.e. emergencies and general cleanup); an emergency plan regarding spills has been developed which includes call-out procedures, fan-out procedures, and procedures for recovering and storing spilled contaminants;

xiii) attending public information meetings on issues related to groundwater management and protection; and

xiv) reviewing proposals for new subdivisions and providing input to environmental impact assessments.

4.1.2 The Environmental Protection Branch

This Branch is responsible for:

i) management of municipal solid waste;

ii) hazardous waste;

iii) water utilities;

iv) wastewater treatment and facilities;

v) air emissions; and

vi) evaluation of plans for new subdivisions.

Under this mandate, the Branch manages landfill sites (see Section 5.9), the evaluation of proposed new subdivisions, municipal water supply and sewer systems (including financial support for such systems) and other aspects of solid and hazardous waste management. The Branch also advises the Building and Technical Services Division of the Department of Community and Cultural Affairs about the environmental effects of any construction regulated under the Planing Act (e.g. manure piles, ponds, subdivisions, lagoons, etc.).

For planned new subdivisions, the developer is required to provide soil tests and test wells at sites chosen by the Department.

4.1.3 The Emergency Measures Organization

This organization, located in Summerside, develops contingency plans for such emergencies as disasters, accidents and spills. An emergency communication network has been established.

4.2 THE DEPARTMENT OF COMMUNITY AND CULTURAL AFFAIRS

The Building and Technical Services Division controls construction and issues permits for any construction under the Planning Act. Permits are only issued if no major harmful environmental effects will result from construction regulated under the Planning Act. The Property Development Section is also responsible for enforcing the Sewage Disposal Regulations of the Environmental Protection Act regarding private sewage disposal. Septic tank installations require permits and are inspected before being covered.

4.3 THE DEPARTMENT OF HEALTH AND SOCIAL SERVICES

The Environmental Health Division within the Department of Health and Social Services has ultimate responsibility for drinking water where it may affect public health. It inspects water and sewage systems at such public establishments as restaurants, motels, tourist homes, hospitals, schools, and senior citizens' homes. When water quality problems are detected, the Water Resources Branch of the Department of the Environment is contacted to follow up and provide technical advice.

4.4 THE DEPARTMENT OF TRANSPORTATION AND PUBLIC WORKS

The Highway Maintenance Branch of the Department is responsible for road salting (application rate, storage piles, etc.) and will, after consultation with the Department of the Environment, redrill wells that have been contaminated by road salt and relocate storage piles.

The Department, in collaboration with the Department of the Environment, has had a program to evaluate the effects of mixed sand/salt piles (5-6 percent salt). Under this program, some piles have been relocated from sensitive areas (see section 2.4).

4.5 THE DEPARTMENT OF AGRICULTURE

This Department is responsible for the Pesticides Control Act. In consultation with the Department of the Environment and the Department of Health, the Department issues regulations, requirements or user permit systems to prevent or limit contamination

of drinking water by pesticides. In 1987, for example, the Department of Agriculture developed a permit system to restrict the use of aldicarb.

The Department also has guidelines for manure management. Under these guidelines, manure storage facilities (lagoons, etc.) must be capable of storing manure and retaining it for at least 1/2 year. Structures for manure retention may also be regulated through the Planning Act by the Department of Community and Cultural Affairs (see Section 4.2).

4.6 THE PESTICIDES ADVISORY COMMITTEE

The Committee, composed of representatives of the federal and provincial governments, industry, suppliers and farmers, makes recommendations on the use of pesticides and reports to the Minister of Agriculture. The introduction of the user permit system for aldicarb in 1987 is the result of one such recommendation.

The committee holds at least one public meeting each year during which the public can voice its ideas and concerns.

5. GROUNDWATER MANAGEMENT - OTHER INSTRUMENTS

5.1 MONITORING

5.1.1 Water Level Monitoring

Twelve water-level monitoring wells across the province are operated by the Department of the Environment (Water Resources Branch). Data for the last 18 to 20 years from these wells are available at the Branch.

5.1.2 Water Quality Monitoring

i) Groundwater around four landfill sites in the province is regularly monitored (one to four times a year) by the Department of the Environment (Water Resources Branch).

ii) Pesticides and nitrates in private wells are regularly monitored by the Water Resources Branch, sometimes in collaboration with Environment Canada or Agriculture Canada. In the past, the pesticides of most interest were aldicarb and to a lesser extent disulfoton, phorate, and metribuzin. The studies are now being extended to other pesticides such as atrazine and dinoseb. A detailed study of nitrates in groundwater is now underway.

iii) Since 1985, the National Water Research Institute (Environment Canada), in collaboration with the Department of the Environment (Water Resources Branch) and the University of New Brunswick, have been monitoring aldicarb and its decomposition products at three sites.

iv) Once a year, all public water supplies (municipalities, camp grounds, schools, senior citizens' homes, restaurants, hotels) are sampled for bacteria by the Community Hygiene Division, Department of Health and Social Services. Chemical tests are carried out by the Water Resources Branch. Some municipalities (Charlottetown and Summerside) do their own monitoring.

v) The Department of Tourism can decertify ("delist") establishments whose water does not meet quality requirements.

vi) Two federal departments (Health and Welfare Canada and Environment Canada), together with the provincial authorities (Department of the Environment), have conducted a four-year survey to monitor public water supplies in the Atlantic provinces. Environment Canada sampled and analyzed raw water supplies, and Health and Welfare Canada treated water supplies. Forty water supplies (ten in each province) have been sampled each year for four years. The first survey in P.E.I. was conducted during Summer 1986. Raw water is analyzed for major

ions, metals, and other standard drinking water parameters, for pesticides (organophosphates, organochlorines, carbamates), and for PCB's, chlorinated benzenes and phenols, and PAH's. Treated water is analyzed for volatile organic compounds (chlorinated alkanes and alkenes, aromatics, and a few others). On Prince Edward Island, all public supplies being tested are from groundwater sources.

vii) During 1985 to 1987, Agriculture Canada, in coordination with the provincial government and other federal departments, monitored public water supplies across Canada for certain pesticides. On Prince Edward Island, carbamates, triazines, phenoxyaliphatic acids, and acetanilides were monitored. Private wells in the Atlantic Region were monitored for phenol derivatives and carbamates. In 1988 and 1989, Agriculture Canada sampled about 40 wells for seven carbamates. The Department of the Environment (Water Resources Branch) together with Environment Canada, in a complementary program, sampled about 100 wells for phorate, disulfoton and metribuzin. In 1989, atrazine and dinoseb were added to the sampling program and 516 samples were analyzed for these pesticides. Aldicarb in private wells was monitored in a separate program (35 wells).

viii) Observation wells at the Charlottetown Airport are being monitored by Environment Canada (Inland Waters Directorate); they are being sampled four times a year for hydrocarbons, de-icing chemicals, nitrates and other inorganic parameters.

ix) The Department of the Environment (Water Resources Branch) regularly monitors for chloride in wells adjacent to road salt storage sites.

5.2 MAPPING, CLASSIFICATION, AND WELLHEAD PROTECTION PLANS

5.2.1 Hydrogeologic Mapping

Hydrogeologic maps for the Winter River watershed (Charlottetown water supply) and the Summerside Isthmus have been prepared. The hydrogeology of the rest of Prince Edward Island has not been mapped in detail.

5.2.2 Classification of Sensitive Areas

A classification system has been developed for areas which are particularly sensitive to contamination by leaking underground storage tanks (Department of the Environment, Water Resources Branch).

5.2.3 Groundwater Resource Evaluation

Under a federal-provincial agreement, the P.E.I. Water Resources Branch and Environment Canada (Inland Waters Directorate) have begun to evaluate available water resources in 10 selected communities on Prince Edward Island which utilize private domestic wells. The emphasis is on the identification of areas whose watersheds have the potential for development as municipal water supplies, and on protection of existing supplies. The expected results of this evaluation are data, maps, and other information which will then be made available (see Section 5.5). Some drilling and pump testing is also included in this evaluation.

5.3 DATA COLLECTION

5.3.1 Water Well Records

Under the Environmental Protection Act, Water Well Regulation of 1990, records for every well drilled or dug must be submitted to the Department of the Environment (Water Resources Branch). The Department has been collecting drillers' logs since 1970 and now has a computerized data base with information on 12,000 wells. From 500 to 1,000 new well records are added annually. The number of older wells not recorded is estimated to be between 20,000 and 30,000 (Walker and Partners, 1987).

5.3.2 Groundwater Quality Data Base

A computerized data base of results of analyses of groundwater samples has been established.

5.4 TECHNICAL AND FINANCIAL SUPPORT

i) Regional landfill sites are selected, established, and closed by the Department of the Environment (Environmental Protection Branch) and operated under contract to the Department.

ii) Grants for some municipal water and sewer systems are available under the Environmental Servicing Assistance Program from the Department of the Environment. Eligibility for the program is based on need. The Department and the municipality share the costs on a 50:50 basis.

iii) Where needed, assistance for improvement of private septic systems and wells can be obtained under the Rural Home Assistance Program operated jointly by the P.E.I. Housing Corporation and Canada Mortgage and Housing Corporation.

iv) There are no well inspectors in the province to provide regular technical assistance. If requested, technical assistance to well drillers is provided by the P.E.I. Water Resources Branch, Department of the Environment. The only other

technical assistance to water well drillers is provided under the Canada - P.E.I. Water Management Agreement. (See Section 5.7).

v) Sampling and analyses of private wells for bacteria and chemicals is provided by the Division of Community Health on request. Well owners are advised of any problems with the well; they may then obtain technical advice from the Water Resources Branch, Department of the Environment.

vi) The Water Resources Branch gives assistance and advice on salt-water intrusion and other management concerns. The advice is of different types:

a) recommended management practices if intrusion is caused by overpumping or by intersecting strata with saline water and,

b) advice regarding where to find saline water to be used for aquaculture.

vii) Since 1976, the Department of the Environment (Water Resources Branch) has conducted a program to seal hand-dug wells. Under this program, 1,787 wells have been plugged since its beginning.

viii) If a well is contaminated by road salt, it is investigated by the Department of the Environment (Water Resources Branch). If justified, remedial action is taken. The remedy may require the construction of a new well, installation of treatment equipment, or the relocation of salt piles. The provincial self-insurance plan bears the cots of remedial action.

5.5 PUBLIC INFORMATION AND EDUCATION

The public information/education programs on groundwater protection, well maintenance, etc. are provided on request by the Department of the Environment (Water Resources and Planning and Administration Branches). The Water Resources Branch organizes courses for installers of underground tanks once a year.

Pursuant to a federal-provincial agreement, information on water quality, treatment technology, and evaluation of new well construction technology will be made available (see Section 5.2).

5.6 ENVIRONMENTAL IMPACT ASSESSMENTS

As described in section 3.5 of this report, the Minister of the Environment may require an environmental impact assessment (EIA) of any undertaking in the province (section 9 of the Environmental Protection Act). A list of undertakings that may be subject to the process is available from the Department (P.E.I. Department of the Environment, 1989). Environmental impact assessments will be the key instruments for a

proactive approach and for integrated environmental and economic planning for sustainable development. The legal basis and details of environmental impact assessments have been described in section 3.5, while the process (following the interim guideline of the Department of the Environment, 1989) is described below.

The process follows a series of steps:

i) The proponent of any undertaking is required to file a written proposal with the Department.

ii) The Department, if necessary in consultation with an Interdepartmental Technical Review Committee (see below), will determine if an assessment is warranted. It may also consult with municipal authorities.

iii) The Minister will decide if an assessment is required and notify a proponent that the undertaking may proceed or that an assessment must be prepared.

iv) If an EIA is required, the Department informs the proponent, gives public notice, and solicits public input. The proponent then conducts an EIA according to the guidelines of the Department (P.E.I. Department of the Environment, 1989) and in consultation with the Department, and prepares an Environmental Impact Statement (EIS).

v) The EIS is referred to the Technical Review Committee for detailed examination. If acceptable, the EIS is released for public review together with final technical review comments prepared by the Department. In case of strong public interest, the Minister may appoint a review panel to hold public meetings.

vi) Once the assessment process is completed, the Minister will decide whether to deny or to approve the undertaking. If approved, the proponent may proceed with the undertaking, subject to any mitigation procedures proposed in the EIA, and to any other regulatory requirements.

The Technical Review Committee consists of the Environmental Assessment Coordinator and the Directors of the Environmental Protection Branch, Water Resources Branch and Fish & Wildlife Branch from the P.E.I. Department of the Environment, representatives of eight other provincial departments, and a representative from each of Environment Canada and Fisheries & Oceans Canada.

5.7 FEDERAL-PROVINCIAL WORK SHARING AGREEMENT ON WATER RESOURCE MANAGEMENT

Under this agreement ["Agreement between The Department of the Environment (Canada) and The Department of the Environment (Prince Edward Island) respecting the

conduct of studies on water resource management for economic development"] the following activities related to groundwater are being carried out:

Groundwater Resource Evaluation. The available groundwater resources of ten communities are being investigated (supply, recharge areas, etc.) to identify areas for watershed management.

Groundwater Quality. The extent of pesticides in groundwater as found in existing wells is being examined.

Technology Transfer and Public Information. Information is made available on the evaluation of new well construction techniques. A major component of the program is a well construction pilot project using various methods of installing bentonite to seal well casings (to prevent well contamination by surface run-off). P.E.I. well drillers are involved in the pilot project.

5.8 FEDERAL-PROVINCIAL WATER QUALITY AGREEMENT

An agreement between Environment Canada (Water Quality Branch) and the P.E.I. Department of the Environment (Water Resources Branch) was signed in 1989 to establish a water quality monitoring program for the province. Twenty groundwater index stations were designated in 12 major watersheds.

5.9 WASTE MANAGEMENT

A general overview of waste management in Canada and on Prince Edward Island has been given by Glenn and Orchard (1986). Regional landfill sites on Prince Edward Island are established, operated, and closed by the Environmental Protection Branch of the Department of the Environment. At present, there are three regional sites, 39 community disposal sites and six refuse container sites (waste transferred to the Charlottetown incinerator) in the province. Sites are selected according to site selection criteria by committees consisting of the Department and representatives of Community Councils. A final selection is made after public meetings. Operation and monitoring of the sites is contracted out but paid by the Department. About 1/3 (80 tonnes a day) of Prince Edward Island's municipal waste is incinerated at the Charlottetown incinerator.

Storage or disposal of hazardous waste is not permitted on Prince Edward Island. The provincial authorities are considering temporary storage sites for such waste from where it can be shipped to the mainland for disposal. Empty pesticide containers are accepted at the regional sites provided they are properly cleaned (rinsed three times, punctured, and crushed).

5.10 PROGRAM FOR PETROLEUM STORAGE TANKS

Following the enactment of the Petroleum Storage Tank Regulations of 1986 (superseded by regulations of 1990, see section 3.8) the Department of the Environment (Water Resources Branch) has embarked on the following program:

i) Registration of tanks: 2,300 tanks have been registered and details about them entered in a data base.

ii) Courses are held once a year to educate installers in proper installation procedures. These courses are followed by examinations which lead to the registration of installers.

iii) Every summer, inspectors monitor inventory controls at retail gas outlets. These inspections have led to more stations keeping records (from 37 percent to 70 percent within one year).

iv) Tank installations and alterations are inspected (555 tanks were inspected in 1989; of these 110 were leaking).

v) Tanks are being removed under the supervision of the Department. Since 1986, 1,069 tanks were removed. Of 74 tanks removed in 1986, 45 percent showed evidence of leakage.

vi) Sensitive areas are being classified and additional protective measures are being developed for such areas.

vii) Tank purging methods and effects of corrosive soils are being studied.

viii) The possibility of inventory control and of improved protection of above ground heating oil tanks is being studied.

ix) Twenty-one offenses under the Petroleum Storage Tank Regulations are now enforceable via Summary Offence Tickets.

5.11 ENVIRONMENTAL EMERGENCY SPILLS PROGRAMS

The Emergency Measures Organization in Summerside (section 4.1.3) has developed contingency plans for any emergency (disasters, accidents, spills, etc.). An emergency spills plan has been developed, which includes call-out procedures, fan-out procedures, and provisions to recover and store spilled contaminants. The Water Resources Branch responds to all spills on a 24-hour basis. It also has a response procedure for environmental emergency situations.

5.12 WELL CONTAMINATION BY ROAD SALT

The Water Resources Branch, Department of the Environment regularly monitors wells for chloride in areas vulnerable to road salt contamination. Wells thought to be contaminated by road salt are investigated by the Water Resources Branch. As described in section 5.4, point viii, remedial action will be taken if required, with the costs of such action being borne by the provincial self-insurance plan.

5.13 LABORATORIES AVAILABLE FOR ANALYSES

5.13.1 Environmental Services Laboratory, Water Resources Branch, P.E.I. Department of the Environment

This laboratory conducts all bacteriological and inorganic chemical analyses of water, wastewater and food products for provincial government agencies. Other chemical analyses by a provincial laboratory are being done at the Agricultural Research Station, Soil and Feed Laboratory, P.E.I. Department of Agriculture.

5.13.2 Victoria General Hospital Laboratory (Halifax, N.S.)

Analyses for hydrocarbons, chlorinated hydrocarbons, 22 inorganic parameters, and general water analyses can be done at the Victoria General Hospital in Halifax (Nova Scotia Department of Health). Most hydrocarbon and other organic analyses are being done at this facility.

5.13.3 Environment Canada Laboratories in the Atlantic Region

The laboratories of Environment Canada in Moncton, N.B. and in Dartmouth, N.S. provide analytical services for provincial agencies in emergencies but mainly provide support for in-house programs. (The same is true for the laboratory of the Nova Scotia Department of Agriculture in Kentville, N.S.).

5.13.4 Research and Productivity Council of New Brunswick

This laboratory, located in Fredericton, N.B., has been used to perform hydrocarbon and pesticide analyses.

5.13.5 Atlantic Veterinary College, University of P.E.I.

The toxicology laboratory of the College has the capability to perform limited pesticide analyses. They currently (1990) have the methodology to perform analyses for phorate, disulfoton, metribuzin, dinoseb and atrazine (pesticides of current interest in P.E.I.).

In addition, analytical services (e.g. pesticide analyses) are also offered by commercial laboratories in Atlantic and Central Canada.

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